AMENDMENTS TO THE DRAWINGS

Please replace the drawing sheet containing Figures 1A and 1B with the attached replacement sheet.

Please replace the drawing sheet containing Figures 2A and 2B with the attached replacement sheet.

REMARKS

Claims 1-8 are currently pending. Claims 1 and 5 are amended. Claims 9 and 10 are newly added.

I. Correction to Claim 1 and the Drawings

Claim 1 has been amended to correct "aid" to "said".

Applicants' specification describes Figures 1A, 1B, 2A and 2B as "conventional". Accordingly, Figures 1A, 1B, 2A and 2B have been amended to be labelled "Prior Art." See MPEP 608.02(g).

II. The Rejection Under 35 U.S.C. §102 Based on Stalker

Claims 1-3, 8/1 and 8/2, are rejected under 35 U.S.C. 102(b) as allegedly being anticipated by US 2,648,492 (Stalker).

Applicants respectfully submit that the present invention is not anticipated by or obvious over the disclosures of Stalker and request that the Examiner reconsider and withdraw this rejection in view of the following remarks.

As can be seen in FIG. I of Stalker, the distance between the shroud and the hub gradually becomes smaller at a constant rate. With this configuration, the velocity of the fluid flowing through the fluid paths is substantially constant from the blade inlet to the blade outlet. In the present invention, on the other hand, the distance between the shroud and the hub does not greatly become small and suddenly becomes small near the blade outlet. With this configuration, the fluid path can be widened in the region from the blade inlet to the predetermined position, e.g. a position near the center of the blade, and hence the velocity of the fluid

flowing through the fluid path can be reduced. Therefore, the frictional loss in the fluid path can be reduced, and the excellent impeller performance can be thus obtained even if the centrifugal impeller has a small specific speed.

Moreover, the impeller taught by Stalker is a type of axial flow impeller. On the other hand, the impeller according to the present invention is a centrifugal impeller. See also new claims 9 and 10.

Regarding claim 3, the Examiner states that the streamlines of the hub and the shroud clearly correspond to each other. Applicants respectfully disagree with the Examiner's conclusion on the following basis. The impeller disclosed in the Stalker reference is a gas turbine. Generally, vanes of the gas turbine are twisted, as is shown in many technical documents. See, for example, the attached turbine technical document and the attached English language description.

Thus, it is respectfully submitted that the streamlines of the hub and the shroud shown in the Stalker reference do not correspond to each other.

For the above reasons, it is respectfully submitted that the subject matter of claims 1-3, 8/1 and 8/2 is neither taught by nor made obvious from the disclosures of Stalker and it is requested that the rejection under 35 U.S.C. §102(b) be reconsidered and withdrawn.

III. The Rejection Under 35 U.S.C. §102 Based on Wareing

Claims 5-7, 8/5 and 8/6 are rejected under 35 U.S.C. 102(b) as being allegedly anticipated by GB 160474 (Wareing).

Applicants respectfully submit that the present invention is not anticipated by or obvious over the disclosures of Wareing and request that the Examiner reconsider and withdraw this rejection in view of the following remarks.

Claim 5 as amended recites that the blades are arranged at angularly equal intervals in a circumferential direction of the centrifugal impeller and extend outwardly spirally. Because each of the blades is a single member and extends spirally, each of them forms a smooth streamline. The Wareing reference discloses vanes each comprising two vane members. These vane members are not connected smoothly to each other, and therefore each of the vanes does not form spiral. This configuration would cause fluid turbulence at the outer side of the connect portion of the two vane members, resulting in a decrease in pump performance and an increase in pulsation.

For the above reasons, it is respectfully submitted that the subject matter of claims 5-7, 8/5 and 8/6 is neither taught by nor made obvious from the disclosures of Wareing and it is requested that the rejection under 35 U.S.C. §103(a) be reconsidered and withdrawn.

IV. Conclusion

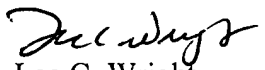
In view of the aforementioned amendments and accompanying remarks, Applicants submit that the present application is in condition for allowance. Applicants request such action at an early date.

If the Examiner believes that this application is not now in condition for allowance, the Examiner is requested to contact Applicants' undersigned attorney to arrange for an interview to expedite the disposition of this case.

If this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. The fees for such an extension or any other fees that may be due with respect to this paper may be charged to Deposit Account No. 50-2866.

Respectfully submitted,

WESTERMAN, HATTORI, DANIELS & ADRIAN, LLP



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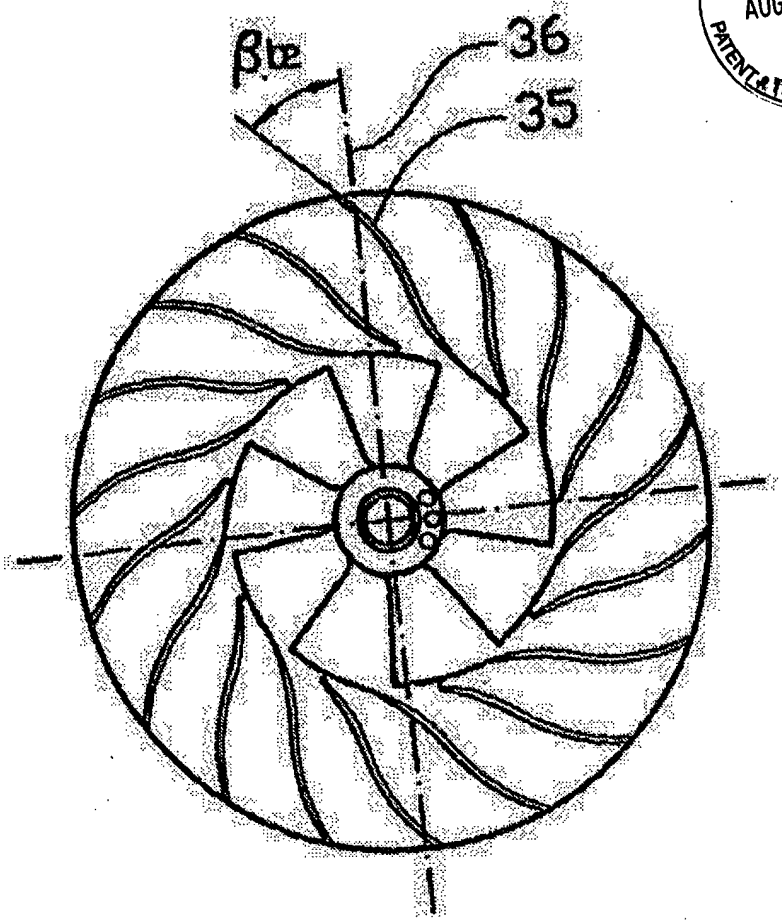
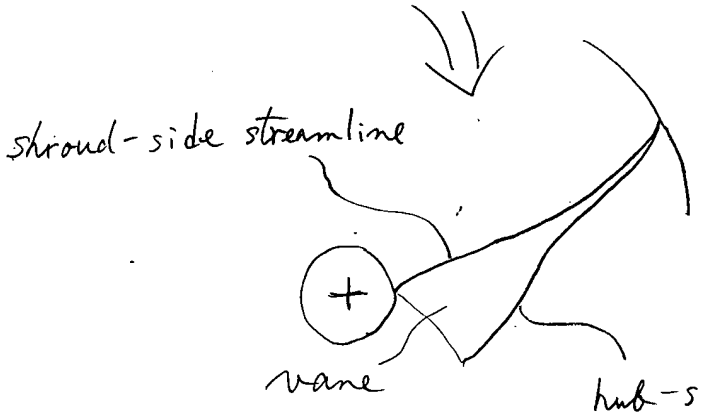
LCW/af
Enclosures: 2 Replacement Sheets of Figs. 1A, 1B, 2A and 2B
Turbine technical document and English language description (2 pages)





In the above structure, when viewed from the axial direction, the shroud-side stream line does not correspond to the hub-side stream line, because the vane is twisted.

23 圧縮機（1）
―圧力を上げるためのメカニズム

空気を高圧にする構造

ガスタービンで使用される圧縮機には流れの方向によって、基本的に次の二つの種類があります。

軸流式は空気が回転軸と平行に流れる形式で、回転体側の動翼（回転翼）と、エンジン本体側の静翼（固定翼）の2種類の翼から構成され、動翼と静翼の1組を1段と呼んでいます。

1段で得られる圧力比（出口圧力を入口圧力で割った値）は高くても2程度と小さいため、大きな圧力比を得るには、軸方向に段数を増やす必要があります。この形式は大流量で、圧縮機の正面の面積を小さくしたい場合に有利です。

遠心式は空気が回転軸と垂直、つまり、半径方向に流れる形式で、インペラ（扇車とも言います）と、インペラの後ろにディフューザ（末広がり形状の通路）が取り付けられており、流速を減速させ圧力回復をしています。

遠心式の大きな特徴は1段当たりの圧力比が最近では10以上と大きくとれる点です。そのため、小型エンジンでは1段だけですむので構造が簡単になります。この形式は小流量の場合が有利ですが、外径が大きくなるきらいがあります。

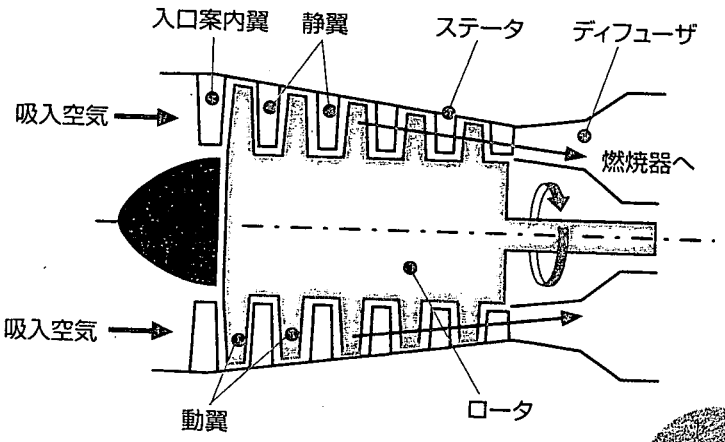
材料としてはステンレス鋼が多いのですが、航空用では軽量化のため温度の低い部分ではチタン系、温度の高い部分ではニッケル系合金が使用されます。

つぎに、圧力が上昇するメカニズムを考えてみましょう。レシプロエンジンでは、ピストンによってシリンダ内の空気を押し込むことによって圧力をあげています。一方、ガスタービンの圧縮機では、回転運動によって空気に速度エネルギーを与えて、それを徐々に減速させることによって圧力を上げています。

空気やガスにはベルヌーイの定理といって、速度を減速させると圧力が上昇する、という性質があります。この原理を応用します。

point BOX
- ●軸流式圧縮機と遠心式圧縮機
- ●レシプロエンジンはシリンダをピストンで押し込んで圧縮
- ●ガスタービンでは回転速度でエネルギーを与えて圧力を上げる

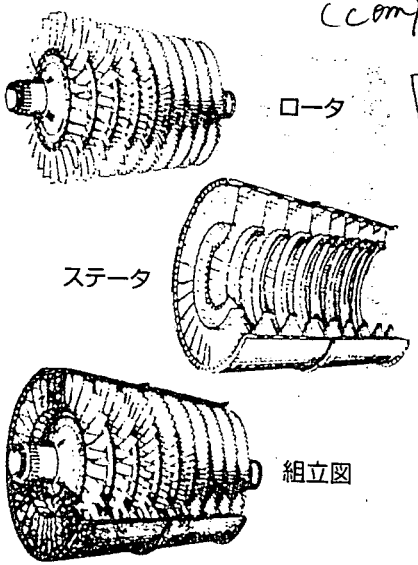
圧縮機の構造



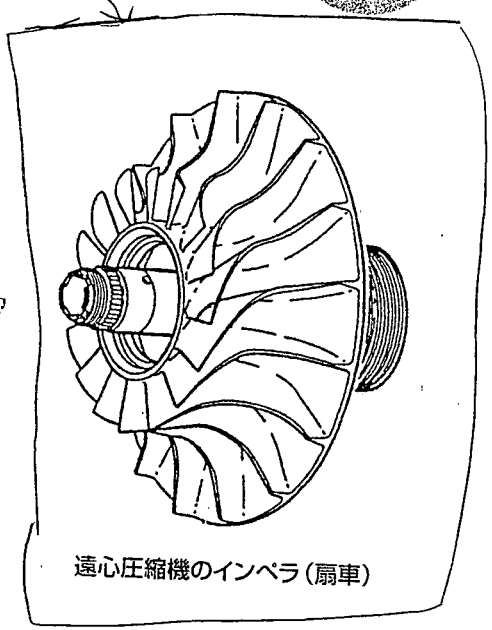
軸流圧縮機の構成

軸流式は大流量、大型向き、遠心式は小流量、小型向き

Gas turbine (compressor)



軸流圧縮機の構造



遠心圧縮機のインペラ（扇車）